**3.4 – Predicting Products of Reactions**

* Now that we have a solid basis of knowledge of chemical reactions, we can begin to predict the products on our own.
* There are a few patterns to watch for…

Combustion

* Combustion reactions are generally pretty easy to spot.
* As a review, note that these reactions have oxygen as a reactant, with carbon dioxide and water as products.
* Usually, the other reactant is something organic (a hydrocarbon, glucose, etc.)
* For example, predict:
  + C2H6 + O2 🡪

Becomes….

* + C2H6 + O2 🡪 CO2 + H2O

The rest is just balancing…

* + 2C2H6 + 7O2 🡪 4CO2 + 6H2O

Synthesis

* Synthesis reactions can be a bit more complicated.
* Remember that synthesis is generally of the formula **A + B 🡪 AB**.
* Many synthesis reactions are simple. For example:
  + H2 + O2 🡪

Becomes…

* 2H2 + O2 🡪 2H2O
* However, there are a few odd synthesis rules that must be followed:
  + Non-metal oxide + water 🡪 ACID (H\_\_\_)
    - Ex. CO2 + H2O 🡪 H2CO3
  + Metal oxide + water 🡪 BASE (Metal OH)
    - Ex. Na2O + H2O 🡪 2NaOH
  + Metal chloride + oxygen 🡪 Metal ClO3
    - Ex. 2KCl + 3O2 🡪 2KClO3
  + Metal oxide + carbon dioxide 🡪 Metal CO3
    - Ex. BaO + CO2 🡪 BaCO3

Decomposition

* This reaction is easy to identify, since there is only ever one reactant.
* There will always be more than one product. Remember the formula **AB 🡪 A + B**.
* For example, predict:
  + Ag2O 🡪

Becomes…

* + 2Ag2O 🡪 4Ag + O2
* Since decomposition is the opposite of synthesis, it is important to note that you could see the synthesis rules applying here as well.
* They would, however, be happening in reverse.
* For example:
  + H2CO3 🡪

Becomes…

* + H2CO3 🡪 CO2 + H2O

Single Displacement

* These reactions can be identified when one of the reactant molecules has only one type of atom, and the other has two. Remember the formula **A + BC 🡪 AC + B**.
* However, there is another set of rules here to follow known as the activity series.

Activity Series

* The activity series is a characteristic of metals and halogens referring to their reactivity.
* This determines whether or not single replacement reactions will occur.
* Refer to your activity series handout, and consider the following:
  + A single replacement reaction **will not occur** if the reactivity of the pure element reactant is **less** than that of the compound reactant.
    - i.e. Sn + NaNO3 🡪 no reaction, because tin is less reactive than sodium.
  + A single replacement reaction **will occur** if the reactivity of the pure element reactant is **greater** than that of the compound reactant.
    - i.e. Zn + H2SO4 🡪 ZnSO4 + H2

Double Displacement

* This reaction occurs between two **ionic compounds**. It involves the exchange of cations.
* Remember the formula **AB + CD 🡪 AD + CB**.
* For example, predict:
  + AgNO3 + NaCl 🡪

Becomes…

* + AgNO3 + NaCl 🡪 AgCl + NaNO3

Acid-Base

* This is simply a special type of double displacement reaction. The format of the reaction is the same, but this is characterized by the formation of water and some type of salt as products.
* Tip: When identifying acid-base reactions, watch for the “H” in one of the reactant and an “OH” in the other reactant. These two combine to make HOH (H2O).
* For example, predict:
  + H3PO4 + Mg(OH)2 🡪

Becomes…

* + 2H3PO4 + 3Mg(OH)2 🡪 Mg3(PO4)2 + 6H2O